

## **TECHNICAL BRIEFING – 2011 ANNUAL SURFACE WATER AND SEDIMENT MONITORING REPORT – GREEN POND BROOK AND BEAR SWAMP BROOK (PICA 193) – DECEMBER 2012**

The document reviewed was an annual report for surface water and sediment monitoring of Green Pond Brook and Bear Swamp Brook for 2011. The annual report reflects chemical and biological sampling that was performed in October 2011. Four previous annual sampling events have been completed as follows: August 2007, October 2008, October 2009, and October 2010. Green Pond Brook extends 22,400 linear feet (LF) through Picatinny Arsenal and Bear Swamp Brook, a tributary to Green Pond Brook, extends 4,400 LF. The drainages were grouped into four regions; the subject of the report is monitoring of Regions 2, 3, and 4 because Region 1 is not affected. Previous remedial work has been four separate removal actions in Bear Swamp Brook from 2000 to 2007.

Samples were collected according to the Facility-Wide Field Sampling Plan and NJDEP Rapid Bioassessment Protocol from the NJDEP Field Sampling Procedures Manual. Sample collection started furthest downstream and then moved upstream.

### Chemical Monitoring

Chemical monitoring included analysis of the following parameters for sediment: pesticides, polychlorinated biphenyls (PCBs), inorganics, polyaromatic hydrocarbons (PAHs), and semi-volatile organic compounds (semi-VOCs). Surface water samples were analyzed for the same list with the addition of volatile organic compounds (VOCs). Sediment results were compared to Remediation Goals (RGs) which were based on Potential Effects Levels (PELs). Results were also compared to ecologically based screening levels – NJDEP Freshwater Sediment Criteria Lowest Effects Level (LEL) and Severe Effects Level (SEL). RGs were not established for surface water. Results were compared to levels of concern (LOCs), which were New Jersey Surface Water Quality Criteria. In the absence of state values, then USEPA Water Quality Criteria were used and in their absence, USEPA Tap Water Regional Screening Levels.

### Biological Monitoring

Biological monitoring consisted of habitat assessment and benthic macroinvertebrate sample collection. Two samples were collected for background reference upstream of Regions 2, 3, and 4. The following quantities were collected from impacted areas: 3 samples – Region 2; 5 samples – Region 3; and 2 samples – Region 4.

#### Habitat Assessment

Habitat assessment was based on 10 metrics. These criteria include the following: variety and quality of substrate, channel morphology, bank structure, and riparian vegetation. Rankings are assigned ranging in value from 0 to 20 with 20 being the best scenario possible. Rankings are tallied for a total value that corresponds to a habitat score with optimal habitat having values of between 160 and 200; and poor habitats having values less than 60.

#### Hilsenhoff Biotic Index (HBI)

The HBI is not discussed in detail in the report other than showing the water quality and degree of organic pollution associated with “modified family biotic index” in Table 2 of the report and noting that lower values of HBI correspond to better water quality (e.g., HBI of 0 to 3.5 corresponds to excellent water quality and unlikely organic pollution whereas values of 8.51 to 10 correspond to very poor water quality with severe organic pollution likely). HBI values are calculated based on the measure of a macroinvertebrate assemblage’s tolerance toward organic enrichment. (Vermont Department of Environmental Conservation)

#### New Jersey High Gradient Macroinvertebrate Index (HGMI)

Benthic macroinvertebrates are evaluated through the HGMI. The HGMI is calculated from seven metrics as follows: total number of genera, percent genera that are not insects, percent of Ephemeroptera/Plecoptera/Trichoptera (EPT) individuals, number of scraper genera, HBI, number of attribute 2 genera, and number of attribute 3 genera. Rankings are combined for a total value aimed at assessing the overall biological condition of the sample location. Excellent biological condition corresponds to an index score of between 63 and 100 which achieves full attainment of the regulatory threshold as does good biological condition (42 to less than 63). Values between 21 and less than 42 are

considered to be representative of a fair biological condition and have non-attainment of the regulatory threshold as do poor conditions associated with index scores less than 21.

#### Sediment Toxicity

Sediment was collected at the sample locations for two types of toxicity studies as follows: *Hyalella azteca* 28-day study and *Chironomus dilutus* long-term exposure study. According to the annual report “*Hyalella azteca* is used as an indicator of relatively high concentrations of contaminants because the organism is epibenthic (living on the surface) and not benthic (living in the sediment being tested) (personal communication with AAT 2011). As such, relatively high concentrations of contaminants must be present in the sediment for the epibenthic organisms to experience toxicity.” This is in contrast to the other species used for toxicity testing: “The lifestyle of *Chironomus dilutus* does not allow the organism to leave the sediment during its early developmental stages. The larval stage of the organism builds tubes and stays in the sediment being tested for the duration of the test period, usually only coming out for food. Therefore, *Chironomus dilutus* are used to indicate if low levels of contamination are present (personal communication with AAT 2011).” For both tests acute toxicity is measured by the percent survival of test organisms and chronic toxicity is measured by mean dry weight (which is a reflection of growth).

#### Results

Biological monitoring including sediment toxicity results are summarized in Tables 1 and 2; chemical results are briefly discussed below.

#### Region 2

Within the twelve contaminants of concern (COC) were detected with two of the COCs having concentrations in excess of the remediation goal (RG) as follows: copper – 1330 milligrams per kilogram (mg/kg) at GPBSD-26 compared to RG = 261 mg/kg; and Aroclor 1260 – 6750 micrograms per kilogram (ug/kg) at SD52-5 compared to RG = 2000 ug/kg.

#### Region 3

Out of nine sediment samples, 13 COCs were detected. Exceedances of the RGS for seven COCs were found in two of the samples as follows:

#### SDBS-24

- Cadmium – 123 mg/kg compared to RG = 34 mg/kg
- Chromium – 2690 mg/kg compared to RG = 247 mg/kg
- Copper – 1500 mg/kg compared to RG = 261 mg/kg

#### SDBS-23

- Benz(a)anthracene – 11,200 ug/kg compared to RG = 2,200 ug/kg
- Fluoranthene – 26,400 ug/kg compared to RG = 4,000 ug/kg
- Phenanthrene – 16,200 ug/kg compared to RG = 5,400 ug/kg
- Pyrene – 21,000 ug/kg compared to RG = 3,800 ug/kg

#### Region 4

Four sediment samples and one surface-water sample were collected for chemical analysis. One sample was detected with a COC in excess of the RG: SD34-4 – copper at 1760 mg/kg compared to RG = 261 mg/kg. Zinc (2000 mg/kg) and lead (3480 mg/kg) were found in excess of their PELs which are 456 mg/kg and 2500 mg/kg, respectively. No COCs were detected in the surface-water sample but arsenic (0.0109 milligrams per liter [mg/L]) was detected in excess of the LOC (0.00138 mg/L).

#### Data Trends

Results of the five sampling events were reviewed to determine whether changes had occurred at the various sampling locations. Both chemical and biological results were reviewed as part of the report. It was concluded that concentrations of chemicals were generally either stable or decreasing in all three regions. Based on the biological monitoring all of the locations had less than optimal habitat ratings and ranged from moderately to severely impaired. The report does note that it is not clear whether impairments are the results of physical changes in the habitat (they cite such changes as sedimentation, scouring caused by higher runoff peaks, low summer flows, and elevated summer water temperatures) and/or chemical contamination. Some locations could not be adequately assessed at times over the five sampling episodes due to insufficient organisms being present.

#### Proposed Monitoring Program Changes

Based on the exit strategy in the Remedial Action Work Plan (RAWP) and in accordance with the Record of Decision (ROD) which states that monitoring results will be reviewed after a five-year period,

recommendations for monitoring program changes were included in the 2011 Annual Report. The RAWP contained a matrix to evaluate whether monitoring would be discontinued based on toxicity, benthic impairment, and preliminary remediation goal exceedances and the frequency of the results.

Region 2, Area H of Region 3, and Region 4

Based on the results and the decision matrix the following changes were proposed:

- Discontinue monitoring:
  - Region 2 locations: 31SD-4 and SD52-5;
  - Region 3 locations: BSSD032, BSSD-29, BSSD-15, BSSD-34, and BSSD-1; and
  - Region 4 locations: SD34-5 and 34SD-7.
- Extend annual monitoring for an additional five years:
  - Region 2 locations: GPBSD-26 and SD101-1;
  - Region 4 locations: SD34-3 and SD34-4; and
  - Surface-water sample location: 34SW-8.

The plan is to perform another evaluation of sample locations during the next 5-year review in 2016.

Area D of Region 3

Based on statistical analyses showing that there are no increasing trends in chemical concentrations the report recommends that the sample of SDBS-23 and SDBS-24 be discontinued. Annual monitoring for SDBS-25 will continue for another five years.

#### Bottom Line by the Reviewer

All of the monitored locations (except background reference) are still impaired to some extent and have some exceedances of monitored chemicals. Although some cleanups have taken place to remove hot spots of sediment and separator contamination; and historical contaminant discharges to the streams have ceased, the streams do traverse industrial areas of Picatinny Arsenal where they may receive runoff causing adverse impacts. In addition, due to the long history of discharges to the streams it may require many years before significant improvements are realized. However, it should be noted that in a

majority of sample locations, concentration trends for contaminants within surface water and sediment are either stable or declining based on samples collected annually over a five-year period. Both chemical and biological monitoring will continue in accordance with the ROD although some locations have been removed from the program based on stability or decrease of monitoring results over the five annual sampling events.

Table 1. Summary of Biological Monitoring Results

Region	ID	Habitat	HBI	Water Quality	Degree of Organic Pollution	HGMI	Biological Condition	Regulatory Threshold
Background reference	GPB-2	Optimal	5.97	Fair	Fairly substantial likely	47.7	Good	Full attainment
	1515R-2	Suboptimal	6.81	Fairly poor	Substantial likely	50.3	Good	Full attainment
Region 2	GPBSD-26	Suboptimal	5.37	Good	Some organic pollution probable	34.2	Fair	Non-attainment
	31SD-4	Suboptimal	7.10	Fairly poor	Substantial pollution likely	18.9	Poor	Non-attainment
	SD52-5	Suboptimal	NA	NA	NA	NA	NA	NA
Region 3	BSSD-32	Suboptimal	9.17	Very poor	Severe pollution likely	27.5	Fair	Non-attainment
	BSSD-29	Suboptimal	6.29	Fair	Fairly substantial pollution likely	38.9	Fair	Non-attainment
	BSSD-15	Suboptimal	NA	NA	NA	NA	NA	NA
	BSSD-34	Suboptimal	5.03	Good	Some organic pollution probable	45.2	Good	Full attainment
	BSSD-1	Suboptimal	7.05	Fairly poor	Substantial pollution likely	52.3	Good	Full attainment
Region 4	SD34-5	Suboptimal	5.38	Good	Some organic pollution likely	31.1	Fair	Non-attainment
	34SD-7	Suboptimal	5.26	Good	Some organic pollution likely	32.2	Fair	Non-attainment

Table 2. Summary of Sediment Toxicity Results

Region	ID	<i>Hyallela azteca</i> mean 28-day percent survival ratio	<i>Hyallela azteca</i> mean 28-day dry weight ratio	<i>Chironomus</i> <i>dilutus</i> mean 20-day survival ration	<i>Chironomus</i> <i>dilutus</i> mean 20-day Ash free dry weight ration	<i>Chironomus</i> <i>dilutus</i> mean Long-term percent survival ratio	<i>Chironomus</i> <i>dilutus</i> mean long-term percent emergence ratio
Background reference	GPB-2	3.53	NA	2.67	NA	3.39	2
	1515R-2	0.93	0.92	4.81	NA	6.34	3.74
Region 2	GPBSD-26	63.46	NA	--	NA	--	--
	31SD-4	0.98	1.13	2.00	NA	4.32	2.55
	SD52-5	0.93	0.74	2.4	NA	3.49	2.06
Region 3	BSSD-32	1.03	1.51	1.72	NA	3.39	2.00
	BSSD-29	1.2	1.57	2	NA	2.79	1.65
	BSSD-15	0.89	0.8	3.42	NA	3.39	2.07
	BSSD-34	1.38	NA	23.81	NA	98.9	58.3
	BSSD-1	0.98	0.68	2.28	NA	4.75	2.80
Region 4	SD34-5	1.01	3.22	1.92	NA	3.96	2.33
	34SD-7	1.24	2.98	3.69	NA	3.49	2.06

Sediment toxicity test results are given as a ratio of the control sample to the field sample. Report states that values less than or slightly greater than 1.0 denote results similar to control tests. Shading indicates statistically significant results compared with the control.

NA – Insufficient specimens were contained in the sample matrix to make a valid metric determination according to NJDEP protocol.